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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/936,551	12/28/2001	Ian Bennion	P/61761-PCT	7129

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EXAMINER	
KNAUSS, SCOTT A	

ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 03/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/936,551	BENNION ET AL.
	Examiner	Art Unit
	Scott A Knauss	2874

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 20-38 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 20,23-29,31-33 and 36-38 is/are rejected.

7)☒ Claim(s) 21,22,30,34 and 35 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 20,23,28,29,32,33,37 and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,451,772 (Narendran).

Regarding claims 20 and 23 Narendran discloses in fig. 6 a distributed fiber sensor for sensing strain (see abstract) comprising:

a waveguide (optical fiber) #10;

a plurality of reflecting structures #12 spaced lengthwise along the waveguide;

each reflecting structure having a reflectivity for reflecting light at a different characteristic wavelength (see fig. 9, which shows responses #52,#54 at different frequencies, and thus different wavelengths), the wavelength changing in dependence upon a change of physical length of at least part of a respective reflective structure (see column 3, lines 17-27, which discusses how the change in length causes a phase shift, which would inherently change the wavelength reflected)

Furthermore, Narendran discusses in column 4, lines 43-51 and fig. 9 using adjacent structures with different reflectivities in order to discriminate the responses from the two reflecting structures.

Regarding claims 28 and 32, Narendran discloses a strain sensing system and method with all the limitations set forth in the claim as set forth above regarding claim 20, further comprising:

a light source #18 applying light to the waveguide, the source inherently covering a range of wavelengths over which the reflecting structures reflect (since the reflecting structures reflect signals at different frequencies)

a detector means (#28,#30,#60 and #32) designed to determine a change in frequency (and thus wavelength) at which the reflecting structures reflect light, the change being indicative of a change in length of at least part of the respective reflective structure (see column 3, lines 17-27,31-37)

Regarding claims 29 and 33, Narendran discloses using the phase shift (and thus the change in wavelength reflected) to monitor the strain

Regarding claims 37 and 38 Narendran, discloses in fig. 17 placing reflective structures at locations #74 and #76 on an object #70, in physical and thermal contact with an object in order to perform temperature and strain measurements. In such a configuration, the change in length and/or temperature of the object causes a change in physical length of a reflective structure (see column 3, lines 15-19) which can be sensed by a detector.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 20,23-29,31-33 and 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,748,312 (Kersey et al.) in view of Narendran.

Regarding claims 20,23 and 25, Kersey discloses a strain sensing apparatus in fig. 5 comprising:

An optical fiber

A plurality of Bragg grating reflectors (FBG's) spaced lengthwise along the fiber, each reflecting structure having a reflectivity for reflecting light at a different characteristic wavelength ($\lambda 1$ - λN), the wavelength changing in response to the stretching (lengthening) of the reflecting structure (see column 1, lines 22-25, column 9, lines 22-25)

Kersey does not, however, disclose the use of reflectivities which are different for adjacent reflecting structures.

Narendran, on the other hand, as stated above, discloses the use of a plurality of reflective structures along an optical fiber sensor, and the use of different reflectivities of adjacent reflective structures (see column 4, lines 43-51) to more clearly differentiate discrete responses from the reflective structures.

Therefore it would have been obvious to one of ordinary skill in the art to modify the sensing system of Kersey by varying the reflectivities of each adjacent reflective structure in order to more effectively differentiate between responses from each respective reflective structure.

Regarding claim 24, Kersey, as stated above, discloses stretching the grating, and thus changing the pitch of the grating in order to change the reflected wavelength of the grating.

Regarding claims 26 and 27, Kersey fails to disclose the use of an optical waveguide including a photo-refractive dopant, and in which each grating structure is written into the fiber, more particularly a fiber comprising silica doped with germanium oxide.

Nevertheless, it is well known in the art to write bragg gratings into optical fibers by exposing a silica fiber with a photorefractive dopant such as germanium oxide with a periodic structure such as a phase mask in order to write a bragg grating into a fiber. Such a fiber is desirable, because it enables gratings to be easily written into the fiber.

Therefore it would have been obvious to one of ordinary skill in the art to use a silica fiber doped with germanium oxide as the fiber of Kersey in order to write Bragg gratings into the fiber and thus provide a plurality of sensors in the fiber.

Regarding claims 28 and 32, Kersey, as modified by Narendran, discloses a sensing system and method in figure 5 with all the limitations set forth in the claim as set forth above regarding claim 20, and further discloses:

A broadband light source #62 applying light to a fiber, inherently having a wavelength range which covers at least a range of wavelengths over which the reflecting structures reflect

Detector means #50,#68 for determining a change of characteristic wavelength at which the reflecting structures reflect light (see column 9, lines 20-24), the change being indicative of a strain on the grating, which causes a change of spacing (length) of the reflective structure (column 1, lines 22-25)

Regarding claims 29 and 33, the detector means determines the change in wavelength based on light which has been reflected back towards a coupler #48 in fig. 4.

Regarding claim 31 neither Kersey or Narendran disclose the use of the relative magnitude of an intensity of reflective light to discriminate between adjacent reflecting structures.

Nevertheless, since Narendran does, in fact, disclose that the relative intensities of the reflective responses of respective reflective structures can be used to differentiate between the structures (see esp. fig. 9 and accompanying description) and that such a configuration is desirable to discriminate between adjacent structures even more (see column 4, lines 43-51) it would have been obvious to one of ordinary skill in the art to

provide a means to discriminate between the respective structures in order to better differentiate the responses from adjacent reflective structures.

Regarding claim 36, fig. 5 of Kersey, as modified by Narendran, does not disclose sweeping the wavelength of light applied to the strain sensor of fig. 5.

Kersey does, however, disclose in fig. 4, #42 and column 8, lines 10-22 using a tunable laser, and tuning the laser wavelength of a tunable laser to each individual wavelength of respective FBG's, thus "sweeping" the wavelength applied to the strain sensor to analyze the response of each individual FBG sensor.

Thus it would have been obvious to one of ordinary skill in the art to "sweep" the laser wavelength in the sensing system of Kersey, as modified by Narendran, in order to analyze the response of each individual sensor.

Regarding claims 37 and 38, fig. 5 of Kersey, as modified by Narendran, does not disclose securing or placing the fiber gratings sensors (FBG's) in thermal or physical contact with an object to measure strain via a change in length.

Kersey does, however, disclose a possible use for a sensor system in fig. 1A-1C, wherein a fiber #22 is secured to and in thermal contact with a structure #20, such that strain causing a change in physical length of the object causes a change in physical length of the reflecting structure (grating) by stretching the grating (see column 2, lines 1-5). Kersey also discloses that strain in the form of temperature may be also sensed (see column 1, lines 31-37) which would cause strain, and stretch the FBG sensor.

Thus it would have been obvious to one of ordinary skill in the art to use the

sensing system of Kersey, as modified by Narendran, to measure changes in temperature and physical length of an object in order to sense the status of a desired object.

Allowable Subject Matter

6. Claims 21,22,30,34 and 35 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claim 21 in particular, the prior art fails to disclose a strain sensor, as set forth in claim 20, wherein reflecting structures that reflect at adjacent wavelengths are configured such that one of the reflective structures reflects light at one characteristic wavelength, and the reflecting structure adjacent in wavelength is configured to reflect light at two characteristic wavelengths. Claim 22 is dependent from objected to claim 21, and is also objected to.

Regarding claims 30,34 and 35, the prior art fails to disclose a method of measuring strain as set forth in claims 28,32 and 33, such that the change in characteristic wavelength is measured by the wavelengths at which the *transmission* of light is attenuated. Claim 35 is dependent from objected to claim 34, and is also objected to.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 5,987,197 (Kersey) discloses a strain sensor using bragg gratings having different reflectivities.

US 5,828,059 (Udd) and GB 2,268,581 disclose other sensor systems using bragg gratings.

US 6,072,567 (Sapack) discloses another sensor device using bragg gratings.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Scott A Knauss whose telephone number is (703) 305-5043. The examiner can normally be reached on 9-6 Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rodney Bovernick can be reached on (703) 308 - 4819. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0530.

Scott Knauss

Art Unit 2874

sak
February 19, 2003

HEMANG SANGHAVI
PRIMARY EXAMINER